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The Application of XAPT-based Blended Learning in Piano Courses for Non-Piano Majors in Qinghai Region

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Abstract

Background and Aim: Higher education is undergoing profound changes due to advancements in technology and evolving educational strategies. Although traditional face-to-face teaching remains valuable, blended learning has emerged as a significant trend in global education. This approach enhances the interactivity and personalization of learning by integrating various pedagogical tools and methods. In music education, especially piano teaching, technological advancements, including computer technology and AI, are driving innovation. The incorporation of music software and AI technology offers students a richer and more tailored learning experience, addressing the limitations of traditional teaching methods. Digital-age online music education tools, such as XAPT, provide real-time feedback and personalized advice to piano learners, effectively supporting and complementing traditional teaching approaches and enabling truly personalized education. This study investigated the impact of XAPT-based blended learning compared to traditional piano instruction on student achievement in sight-reading, rhythmic accuracy, and touch-key skills within a piano course designed for non-piano majors. The primary goal was to assess whether the XAPT-based blended learning approach was more effective than traditional one-on-one piano instruction in enhancing student performance across these three skill areas.

Materials and Methods: At the College of Arts, Qinghai Minzu University, 69 non-piano sophomore students were recruited for this study. They were divided into two groups: the control group, which received traditional one-on-one piano instruction, and the experimental group, which underwent a hybrid teaching method based on XAPT. After 6 weeks of instruction, both groups evaluated their performance in sight-reading, rhythmic accuracy, and touch-key skills to determine the effects of their respective teaching methods.

Results: The results indicate that XAPT-based blended learning significantly enhances students' performance in sight-reading, rhythmic accuracy, and touch-key skills. Compared to traditional one-on-one piano lessons, this blended learning approach offers greater flexibility in practice, leading to improved scores in piano lessons.

Conclusion: These findings align with existing research and suggest that the XAPT blended learning approach can enhance non-piano students' performance in sight-reading, rhythmic accuracy, and touch-key skills in piano lessons to some extent.

Keywords: Blended learning; Non-piano students; Sight-reading skills; Rhythmic accuracy; Touch-key skills; XAPT

Introduction

Higher education is continuously evolving with advancements in technology and educational strategies. Blended learning, which integrates online resources with traditional classroom instruction, provides a more flexible approach to education and has been increasingly adopted by universities and colleges worldwide (Conway, 2020).

Blended learning combines face-to-face instruction with online teaching methods, leveraging digital tools and resources to create a more interactive and personalized learning experience (Graham et al, 2016). This approach has gained prominence in education, particularly with the rise of digital technology and the Internet (Kim, 2020). While traditional music education typically relies on face-to-face piano instruction,

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music educators are increasingly exploring blended learning for application in music programs (Nassar et al, 2023).

Globally, music education organizations are increasingly exploring the use of AI in piano teaching. These efforts include employing AI tools to offer real-time performance feedback, thereby enhancing student learning (Crappell, 2019). In China, the demand for AI-driven piano teaching software is rapidly growing as families invest more in music education. Domestic companies have made notable advancements, providing personalized learning recommendations (Huang & Ding). Both internationally and within China, the integration of AI technology in piano teaching is emerging as an irreversible trend, paving the way for innovative opportunities.

With the advancement of social culture and the economy, quality music education has gained increasing importance in China. According to regulations from the Ministry of Education of China (2006), piano has become a core subject for undergraduate musicology majors at general higher education institutions. Despite the requirement for all students to learn piano, non-piano majors often have a limited foundation and may have had little to no prior exposure to the instrument. Consequently, relying solely on weekly piano lessons often does not provide sufficient practice or personalized instruction. Traditional face-to-face teaching struggles to address issues such as inaccurate reading, mispronunciation, and rhythmic confusion.

With the advancement of Internet technology, online music education tools, such as XAPT online piano accompaniment software, have emerged. These tools offer real-time feedback and personalized practice suggestions, making them valuable resources for students with weak fundamentals and helping them practice piano more efficiently (Liu & Shao, 2022). Although AI piano accompaniment software has not yet seen widespread adoption in higher education institutions in China and research on it remains limited, it provides significant support for traditional piano teaching and paves the way for personalized instruction. The exploration and analysis of AI accompaniment technology are crucial for the advancement of piano education.

Objectives

1. To explore whether the research treatment utilizing blended learning methods demonstrates superior performance in sight-reading skills, rhythmic accuracy, and touch key skills compared to conventional teaching methods.
2. To explore whether the post-examination scores of students, when compared between the experimental group and the control group, exhibit improvement over their pre-examination scores.

Literature review

This section examines the integration of the XAPT tool with a mobile blended learning strategy in a piano course, focusing on enhancing and practicalizing after-school practice methods. The content is organized into three parts: first, it outlines relevant technical details and reviews existing literature; second, it constructs a theoretical framework that defines the variables and their relationships, provides assessment methods, and offers a comprehensive overview of blended learning theories, connectionist theories, and constructivist theories; and finally, it presents the study's hypotheses.

Xiaoyezi AI Piano Tutor（XAPT）

Founded in 2013, Little Leaf (Beijing) Technology Co., Ltd. is an AI-driven music education company committed to enhancing the engagement and efficiency of music education through innovative products. Xiaoye, a pioneer in intelligent accompaniment, employs AI for error correction in piano learning. Currently, XAPT serves users in 131 countries worldwide.

XAPT offers two main functions: AI piano accompaniment and real teacher accompaniment. This study specifically focuses on the AI piano accompaniment feature. The AI intelligent accompaniment uses the electronic device’s recording function to recognize piano sounds. The process involves three steps: recognition of music scores, enhancement, and assessment. Students begin by uploading the appropriate

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sheet music from the software's library, choosing to practice with one or both hands. As they play, notes are indicated by a cursor; correct notes turn green with a star, while incorrect notes turn red. At the end of the practice session, the system scores the performance. Additionally, XAPT provides lessons in sight singing, ear training, and music theory, along with music theory questions and mini-games to make practice more enjoyable. Students can earn points through AI accompaniment and game tests, which contribute to badges and leaderboard rewards.

Blended learning teaching methods

Blended learning is an innovative educational model that combines traditional face-to-face instruction with modern online learning. This approach leverages advanced technology to facilitate effective sharing and interaction of educational resources. Many educational institutions, particularly universities, have adopted blended learning to foster a more autonomous and flexible learning environment (Garnham & Kaleta, 2002).

Blended learning originated in the 1990s, with advancements in technology and the Internet paving the way for its development. Over time, this model has evolved into a significant educational approach. Blended learning is not merely a combination of traditional and online instruction; it represents an integrated approach that enhances both. While traditional classrooms offer a solid foundation, blended learning increases instructional interactivity, provides access to diverse learning resources, and overcomes geographical and temporal constraints (Bryan, 2016).

Research indicates that blended learning offers notable benefits in improving student achievement, initiative, and social interaction. For instance, Al-Qahtani and Higgins (2013) found that blended learning significantly boosts student achievement. Bos et al (2016) observed that the model enhances student initiative and creative thinking, while Rovai and Jordan (2004) concluded that blended learning fosters increased social interaction and a stronger sense of community among students. These findings collectively suggest that blended learning positively impacts student learning outcomes.

However, blended learning is not ideal for every educational context. Educators must carefully consider their specific pedagogical goals and the needs of their students when selecting this model. Additionally, blended learning presents challenges, including the necessity for educators to possess technological skills to effectively integrate online and offline resources. Effective implementation also requires thorough instructional design and planning to ensure the seamless integration of both components. Furthermore, the successful adoption of blended learning depends on the availability of high-quality online programs, effective pedagogical tools, and robust technical support.

Overall, blended learning offers students a more autonomous and flexible learning environment by combining the benefits of traditional teaching with online learning. However, it also faces several challenges. Educators must continue to explore and innovate to ensure its effectiveness and feasibility in actual teaching and learning.

Teaching methods are progressively transitioning from traditional models to blended learning. Despite the widespread use of lecture-based teaching, its effectiveness has faced criticism (Deslauriers et al., 2011). To enhance learning outcomes, learners must adopt an active approach (Dori & Belcher, 2005). Experts recommend that blended learning should transform teachers from "narrators" into "facilitators" and encourage students to become more active rather than passive participants. Blended learning boosts student engagement through flipped classrooms, online interactions, and self-directed learning (Yan et al., 2022). Research indicates that blended learning is more effective than traditional instruction (Rajeh Alsalhi et al, 2021), not as a replacement but as a new model that integrates the benefits of modern Internet technologies.

Online Piano Teaching

In recent years, the rapid advancement of information and communication technology has introduced numerous electronic tools that enhance the practical aspects of piano learning. These technological innovations have addressed the limitations of traditional piano education methods, leading to the adoption of new educational strategies. The use of multimedia and internet technologies has spurred

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the development of online piano tutorials (Bilen, 2021), revitalizing the conventional approach to music education and motivating students (Grigorkevich et al., 2022). The integration of intelligent technology provides new opportunities for transforming music education (Kwak et al., 2020).

Mobile learning applications enhance education by offering greater efficiency, interactivity, and autonomy (Nykvist et al., 2021). When combined with traditional methods, these applications create innovative blended programs for music learning. Online music programs promote the use of electronic resources, thereby improving critical thinking and information processing within digital environments (García et al., 2021).

The study identified several popular online piano lesson apps: Xiaoyezi AI Piano Tutor, Skillshare, The One Music Group, and goodEar Pro. Xiaoyezi AI Piano Tutor was cited by 29% of students as a key tool for improving polyphony skills through melodic performance analysis. Skillshare was mentioned by 27% of students for reinforcing piano skills and fostering creative thinking. The One Music Group was cited by 24% for speeding up learning and enhancing concentration with note colors. Goodyear Pro was cited by 20% of students as the least critical tool, primarily due to its focus on theoretical learning (Liu & Shao, 2022).

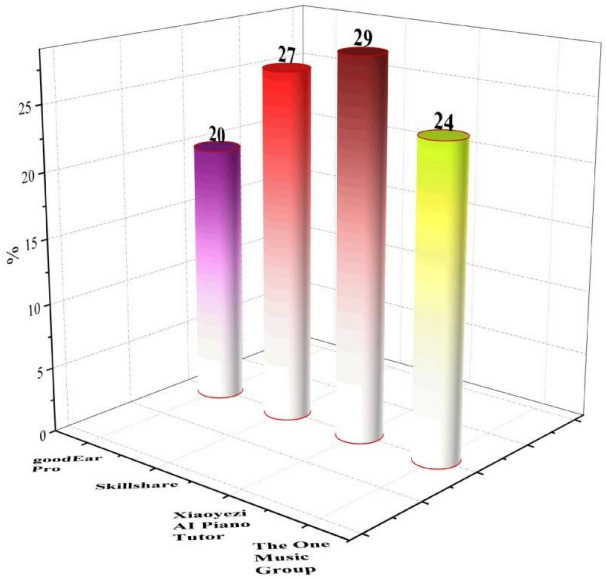

Figure 1 Common piano online course applications

Connectionist theory

Connectionism is a theoretical framework that views learning as a phenomenon occurring within social and technological networks (Harasim, 2017). It has its foundations in chaos theory, network theory, complexity theory, and self-organization theory, and is influenced by connectionism, associationism, and graph theory. According to connectionism, learning, and knowledge are achieved through the connections between different nodes or sources of information. It emphasizes that learning is not confined to human devices alone but also involves technology and non-human systems. Connectionism advocates for the cultivation and maintenance of these connections throughout the learning process and considers discovering links between different domains, ideas, and concepts as a core skill. It views accurate and up-to-date knowledge as the ultimate goal of learning, with the decision-making process itself being an integral part of the learning experience (Goldie, 2016).

Unlike traditional objectivism, pragmatism, and interpretivism, connectionism offers an epistemological framework that is well-suited to technological and organizational learning. It emphasizes

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value judgments made within a knowledge-rich environment. In the context of music education, connectionism supports the application of its theory to technology-assisted learning. It helps students identify the connections between keystroke skills, sight-reading skills, and rhythmic accuracy and illustrates how technology (e.g., XAPT) can enhance these skills.

Constructivist theory

Constructivism is a learning theory that emphasizes students constructing knowledge through active thinking and exploration, rather than relying solely on teacher instruction (Simons, 1992). According to this framework, learning is an active process where students develop understanding by satisfying curiosity and resolving doubts. Knowledge is generated through the interaction between the learner and their environment, rather than being passively received from experts. Learners use available resources to create meaningful knowledge through continuous construction, evaluation, and adaptation (Sprague, 1993). Additionally, the depth of learning is closely linked to the activities undertaken, the context of these activities, and the cultural backdrop (Brown et al., 1989).

Constructivism underscores the significance of practice and active participation in knowledge acquisition. In this study, musicology students at Qinghai University for Nationalities (QUNH) utilized XAPT to delve into key-touching skills, sight-reading, and rhythmic accuracy. This hands-on approach not only addressed the students' individual learning needs but also fostered peer interactions, thereby enhancing their absorption and application of knowledge.

Information on the connection between the population and topic/technology

In our country, many music students are not majoring in piano and have limited or no basic piano skills. This deficiency can impact their performance in other music subjects. To improve in their primary areas of study, such as voice or other instruments, students need to develop fundamental piano knowledge and skills (Liu & Shao, 2022).

Non-piano majors are music students specializing in instruments such as violin, guitar, and flute. At the College of Arts of Qinghai Minzu University, sophomores majoring in music, who focus on instruments like voice, flute, and saxophone, are introduced to piano as a new discipline. The sophomore piano curriculum aims to teach fundamental skills such as sight-reading, rhythm, and touch-key techniques. Despite having a solid foundation in their primary instrument, these students face challenges as beginners in piano, although they already have experience in other music areas.

With the rapid advancement of educational technology, blended learning models have become widely adopted in higher education, particularly in music education, where they offer distinct advantages. Blended learning integrates traditional face-to-face instruction with modern online methods, effectively addressing the challenge of combining theory and practice. XAPT, a piano learning tool utilizing advanced sensors and algorithms, provides real-time feedback and guidance to students and assists teachers in monitoring and supporting practice. At Qinghai University for Nationalities, XAPT has become a crucial component of blended learning for non-piano music majors, enhancing both learning effectiveness and teaching quality while paving the way for future developments in music education.

Conceptual Framework

This section provides an overview of the variables and their interrelationships that influence the performance of non-piano students. The study investigated the impact of a blended teaching method based on XAPT compared to a traditional one-on-one teaching method on student achievement. Using a quasi-experimental approach, the study assessed the effects of the blended teaching method on student performance in three areas: sight-reading skills, rhythmic accuracy, and touch-key skills.

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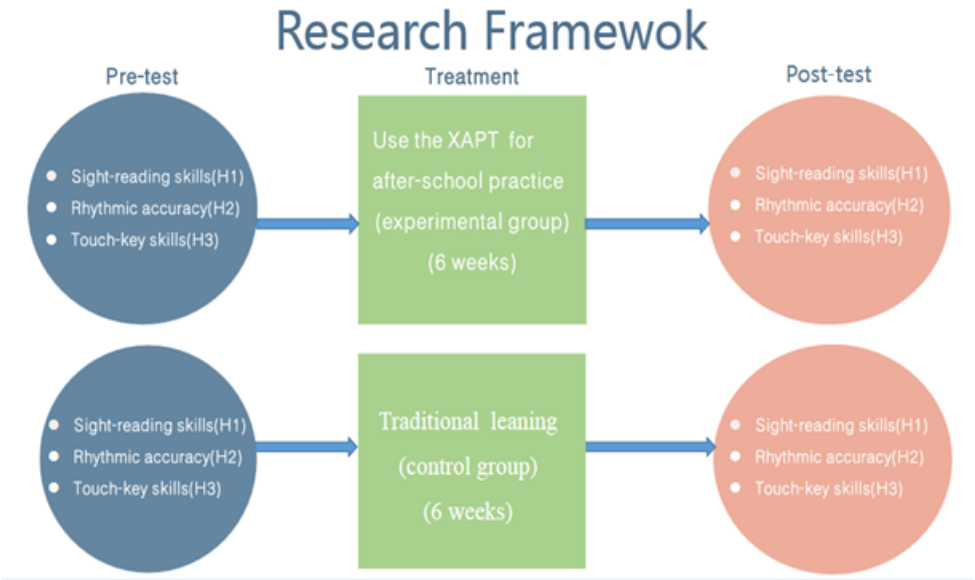

Figure 2 Research Framework

Hypotheses

Based on the literature review and the conceptual framework, the following hypotheses are proposed.

$H_0$1:There is no difference in the sight-reading skills between the experimental group and the control group.

H_a1:There is a difference in the sight-reading skills between the experimental group and the control group.

$H_0$2:There is no difference in the Rhythmic accuracy between the experimental group and the control group.

H_a2:There is a difference in the Rhythmic accuracy between the experimental group and the control group.

$H_0$3:There is no difference in the touch-key skills between the experimental group and the control group.

H_a3:There is a difference in the piano touch-key skills between the experimental group and the control group.

Methodology

Research design

This study employed a quasi-experimental design to evaluate the effectiveness of XAPT in improving sight-reading skills, rhythmic accuracy, and touch-key techniques among non-piano majors in musicology at Qinghai University for Nationalities. The research aimed to develop a new teaching method for these students. The study compared pre-test and post-test scores of students who used XAPT with those who did not, using a two-group design to assess the impact of XAPT versus traditional teaching methods. Data were collected and analyzed quantitatively to address the research questions and test hypotheses. The experiment adhered to academic standards, with a six-week duration, consisting of two 45-minute piano lessons per week. Lessons were split into traditional face-to-face instruction and practice sessions. The control group practiced independently, while the experimental group used XAPT during practice. This setup allowed students to acquire new knowledge in class and practice effectively. The study was organized as follows:

1. In the first week of the experiment, a pre-test was conducted with 69 sophomore students to assess their piano skills before the experimental instruction. The pre-test included one practice piece and one music piece, randomly chosen from the repertoire library for non-piano majors at Qinghai University for

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Nationalities. The repertoire library contained 10 exercises and 10 pieces, and selections for the pre-test were made randomly according to the syllabus requirements. This random sampling approach ensured the fairness and randomness of the test.

2. Following the pre-test, students began the 6-week course. According to the syllabus, the course required students to cover content from three textbooks: HANON Piano Fingerings, BAYER Piano Fundamental Course, and Piano Fundamental Course 1. Each week, students were expected to complete one practice piece and one piece of music.

3. During the six-week teaching program, the researcher implemented a detailed process for both the experimental and control groups, involving two 45-minute lessons per week: one focused on face-to-face instruction and the other on practical exercises. For the experimental group, the weekly lessons included one face-to-face session and one practical exercise using the XAPT tool. In contrast, the control group followed the same lesson structure but practiced independently during the practical exercise without using XAPT. Both groups received the same theoretical content but differed in the technical aids used for the practical component.

Population and sample

The target population for this study comprised 69 sophomore musicology non-piano majors from the College of Arts at Qinghai Minzu University. This included 32 students in the control group and 37 in the experimental group. The gender distribution was as follows: the control group had 15 male students (21.7% of the total) and 17 female students (24.6% of the total), making up 46.4% of the sample. The experimental group had 20 male students (28.9% of the total) and 17 female students (24.6% of the total), representing 53.6% of the sample. Overall, the sample included 35 male students (50.7%) and 34 female students (49.3%).

Qinghai Minzu University, located in Xining City, Qinghai Province, was founded in 1949 and is the oldest higher education institution in the province. The university emphasizes cultural and ethnic integration and serves as a platform for multicultural exchange. Its students come from various states and counties in Qinghai, where resources for music education are limited.

Research Instruments

In this study, the final examination standard for musicology at the College of Arts of Qinghai Minzu University was used as the research instrument. This standard offered a clear, structured framework for evaluating students' knowledge and skills. By employing this standard, the researcher systematically collected and analyzed data on students' performance and progress in sight-reading skills, rhythmic accuracy, and touch-key techniques.

Data collection

Before the experiment began, researchers explained the purpose and procedures to the participants and obtained their consent. The participants were divided into two groups: the experimental group, which used a mobile blended learning approach with XAPT, and the control group, which followed traditional face-to-face instruction combined with self-directed practice.

To collect relevant data, the researcher administered both a pre-test and a post-test to each group. The pre-test aimed to assess the participants' initial levels of knowledge and skills in the relevant areas. After six weeks of instruction, both groups took a post-test to evaluate and compare their progress in sight-reading skills, rhythmic accuracy, and touch-key techniques.

Data analysis

In this study, a quasi-experimental design was employed, with primary data derived from final exam scores assessed by three experienced and professionally qualified reviewers. To ensure fairness and accuracy, the researcher averaged the scores given by the reviewers to determine the students' final assessment scores.

To analyze the data and draw scientific conclusions, the researcher used Jamovi software. An independent samples t-test, a common quantitative method for comparing the means of two groups, was

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conducted to determine if there were significant differences between the groups. The goal was to assess whether the blended learning approach using XAPT improved students' performance on the final exam.

Results

The results of the study are analyzed in detail in this report. The analysis employs inferential statistics and hypotheses to evaluate the impact of a blended learning approach versus a traditional learning approach on the piano performance of non-piano majors. These analytical methods provide important insights from the data and clearly outline the quantitative aspects of the study. Collectively, these elements support a thorough analysis of the study's findings.

The purpose of this study was to evaluate the effectiveness of blended learning compared to traditional piano teaching methods for non-piano majors, focusing on sight-reading skills, rhythmic accuracy, and touch-key skills. The study found that blended learning, utilizing XAPT technology, significantly improved these skills, demonstrating that XAPT is an effective tool. The results indicate that blended learning offers notable benefits in student achievement, initiative, and social interaction (Al-Qahtani & Higgins, 2013). When comparing blended learning with traditional methods, the blended approach proved more advantageous for enhancing sight-reading skills, rhythmic accuracy, and touch-key skills among non-piano majors (Bryan, 2016).

Through a 6-week experiment, data were analyzed separately for the experimental and control groups. The results demonstrated significant improvements in sight-reading skills, rhythmic accuracy, and touch-key techniques among non-piano majors using XAPT during their piano learning. Most studies have noted that blended learning generally enhances academic performance more effectively than traditional classroom instruction (Rajeh Alsalhi et al, 2021).

Hypothesis Testing

In this section, independent samples t-tests were used to assess hypotheses regarding the scores of non-piano majors in sight-reading skills, rhythmic accuracy, and touch-key skills. Based on the course design of XAPT blended instruction, the researcher tested hypotheses Ha1 through Ha3 and found differences in the scores of non-piano majors between XAPT blended instruction and traditional instruction.

Table 1 T-test of Pre-test scores between the two groups

		Statistic	df	p
Pre_Sight reading skills	Student's t	-0.0831 [a]	67.0	0.934
Pre_Rhythmic accuracy	Student's t	-0.674 [a]	67.0	0.503
Pre_Touch key skills	Student's t	-1.29	67.0	0.202

An independent samples t-test was used to compare the pre-test scores for sight-reading skills, rhythmic accuracy, and touch-key skills between the control and experimental groups. The results showed a non-significant t-test for sight-reading skills (P = 0.934), rhythmic accuracy (P = 0.503), and touch-key skills (P = 0.202). Thus, there were no significant differences between the students in the control and experimental groups in these three areas.

The results of the pre-test may not accurately reflect the students' piano skills; however, the academic skill levels were similar between the two groups. In summary, it can be concluded that any differences between the two groups did not affect the results.

Table 2 Summary of the mean values for the two groups of students

	Group	N	Mean	SD

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Pre_Sight reading skills	Control group	32	23.6	3.46
	Experimental group	37	23.6	2.42
Post_Sight reading skills	Control group	32	28.1	2.57
	Experimental group	37	33.2	2.14
Pre_Rhythmic accuracy	Control group	32	24.5	2.54
	Experimental group	37	24.8	1.57
Post_Rhythmic accuracy	Control group	32	26.0	2.01
	Experimental group	37	27.2	1.52
Pre_Touch key skills	Control group	32	21.9	2.88
	Experimental group	37	22.7	2.27
Post_Touch key skills	Control group	32	22.9	2.41
	Experimental group	37	25.1	1.41

As shown in the table above, there were differences in the scores for sight-reading skills, rhythmic accuracy, and touch-key skills between the two student groups in both the pre-test and post-test. These findings indicate that the mean scores of students in both groups increased following the XAPT hybrid teaching method intervention. Initially, the mean scores of the experimental group were lower than those of the control group in the pre-test, but the post-test scores for the experimental group surpassed those of the control group in all areas. Both groups demonstrated significant improvement in their scores after the intervention.

Table 3 T-test of students' Sight reading skills、Rhythmic accuracy and Touch key skills

		Statistic	**df**	**p**
Post_Sight reading skills	Students' t	-8.94	67.0	< .001
Post_Rhythmic accuracy	Student's t	-3.00	67.0	0.004
Post_Touch key skills	Student's t	-4.70 [a]	67.0	< .001

An independent samples t-test was used to compare the improvement in sight-reading skills, rhythmic accuracy, and touch-key skills between the control and experimental groups. The t-test was

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significant at $p<0.5$. Therefore, the null hypothesis was rejected. The results indicated that there were significant differences in sight-reading skills, rhythmic accuracy, and touch-key skills between the students in the control and experimental groups.

Hypotheses

Hypotheses	Statement	Result after Analysis
$H_0 1$	There was no difference in the improvement of sight-reading skills between students in the XAPT-based environment and those learning in a traditional classroom.	Rejected. There is a significant difference between the two groups, $p<0.5$.
$H_0 2$	There was no difference in the improvement of rhythmic accuracy between students in the XAPT-based environment and those learning in a traditional classroom.	Rejected. There is a significant difference between the two groups, $p<0.5$.
$H_0 3$	There was no difference in the improvement of touch-key skills between students in the XAPT-based environment and those learning in a traditional classroom.	Rejected. There is a significant difference between the two groups, $p<0.5$.

Discussion

The purpose of this study was to assess the impact of the XAPT blended learning method on the piano performance of non-piano students. The study analyzed three key competencies in piano learning—sight-reading skills, rhythmic accuracy, and touch-key skills and revealed the differences in these performances between the XAPT blended learning method and traditional face-to-face learning.

After implementing the XAPT blended learning method, it was found that the piano performance of students in the experimental group was significantly higher than that of students in the control group, who received traditional one-on-one instruction. The XAPT blended learning method effectively improved students' piano performance, which can be attributed to two main reasons. Firstly, with advances in technology and evolving educational strategies, higher education is continuously transforming. Since the 1970s, rapid progress in computer technology has led to the widespread use of music software in global education, creating new opportunities for music education. This technological integration not only offers innovative learning methods for students but also provides educators with new teaching strategies. Secondly, the rapid development of internet technology has led to a surge of online music education tools and software. These resources are invaluable for students with limited piano skills, helping them practice more efficiently and scientifically. Internet technology offers strong support and supplementation to traditional piano teaching. In this digital age, online music education tools and software not only provide students with a wider range of learning resources and options but also help educators manage and guide teaching more effectively, facilitating truly personalized instruction (Liu & Shao, 2022).

In today's rapidly evolving world of educational technology, integrating blended learning with traditional teaching strategies has become a key focus for educators. This study provides empirical evidence of the effectiveness of blended instruction in music education by field-testing the XAPT blended learning method alongside traditional teaching approaches. It contributes to the ongoing integration of educational technology with conventional methods.

Conclusion

This study comprehensively investigated the use of XAPT technology in piano teaching for non-piano students in musicology, aiming to assess its enhancement of students' sight-reading skills, rhythmic accuracy, and touch-key skills scores. The study applied XAPT for the first time in this area through blended learning.

The results of the study demonstrated that XAPT had a significant positive impact on the piano learning of non-piano students. The blended teaching model notably enhanced students' sight-reading skills, rhythmic accuracy, and touch-key skills. The experimental group outperformed the control group in these areas, highlighting that XAPT is highly effective in improving these competencies in piano instruction.

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In conclusion, the results of this study suggest that blending XAPT with traditional methods can be a valuable and effective resource for collegiate non-piano majors learning piano. This study contributes to the body of literature on blended instruction and online piano teaching, offering practical insights for both piano teachers and learners seeking innovative ways to enhance piano education. The successful application of XAPT in blended instruction settings within colleges and universities highlights its potential to advance piano education. It also paves the way for further research and development in piano teaching for non-majors.

Recommendation

Based on the results of this study, several areas warrant further research to enhance our understanding and impact of blended learning combined with XAPT in piano instruction for non-piano students. Therefore, we offer the following recommendations for future research:

Expanding Population Diversity and Length of Study: This study was limited to 69 sophomore students from the College of Arts at Qinghai Minzu University, all majoring in musicology with a non-piano concentration, within a specific region. As such, the results may not fully represent a broader population of piano learners from diverse demographic and cultural backgrounds. Future research should include a more diverse group of piano learners and consider expanding the sample size. A larger and more varied sample could provide additional insights into piano learning for non-piano students. Moreover, extending the duration of the study could allow researchers to analyze the long-term effects of XAPT blended instruction on students' piano learning.

Perspective Analysis: To gain a deeper understanding of the experiences of both teachers and students with XAPT, future research should incorporate studies on teacher and student satisfaction, motivation, and perceptions. Examining these perspectives can provide valuable insights into engagement levels and identify potential barriers encountered when integrating XAPT into piano instruction.

Comparison with Other Technologies: To comprehensively assess the impact of technology on piano instruction for non-piano students, future research should compare XAPT with other piano education technologies. This comparative approach would offer valuable insights into the specific strengths and limitations of XAPT, helping to identify its relative effectiveness and areas for improvement.

In summary, the suggested areas for future research have the potential to deepen our understanding of the impact of XAPT on piano education for non-piano majors. Addressing the gaps identified in this study could lead to continuous improvements in piano instruction for non-majors and enhance the overall learning experience for students.

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